Space Weather Technical Forecast

Issued on Wednesday, 12 April 2023 at 13:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout, slight chance of X-class flares (R3 Strong radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with continued C-class activity, mostly from AR3272 and AR3276. There are currently eight sunspot regions on the visible disc. AR3272 in the southern disk remains the largest region on the visible disc with continued development within the multiple intermediate spots. AR3273 near center-disc is the second largest with little change but now classified Dko/Beta. AR3276 near the southeast limb presents difficulties in classification but appears reasonably large and complex at this stage. The smaller spot proceeding it is tentatively recorded as an unnumbered separate development, though some looping between the systems is evident. AR3277 faded somewhat though remains elongated, with two further unnumbered multi spot regions evident in the western disk, these small and relatively simple at this stage. There have been no Earth-directed CMEs observed in available imagery over the past 24 hours, though dimming observed approximately 11/2000 UTC near center disk and a filament liftoff from the SW disk around 12/0300 UTC remain under investigation.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1, was initially enhanced by a weak High Speed Stream (HSS), likely from CH91/+ over the last 24 hours. Solar speeds at 450 km/s have now declined to slow-ambient levels around 360 km/s. Density has been at near to slightly below average levels. The total IMF, Bt, has been weak throughout. The north-south component, Bz, has been varying weakly between +5/-4 nT. The phi angle remained in a resolutely positive orientation (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. The high energy electron flux (greater than 2MeV) as measured at GOES16 was at background levels. The associated 24 hour fluence was below the Active threshold. The 12/0001 UTC observed fluence was 1.61e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with a chance of further isolated M-flares and a slight chance of isolated X-flares. AR3272 and AR3276 are the most likely sources of activity for now.

Solar Wind / Geomagnetic Activity: There are currently no expected Earth-directed CMEs, although there is a low possibility of a glancing arrival on Days 1 and 2 (12-13 April) associated with filament eruptions that left the sun on 9 and 10 of April. Investigation remains ongoing into dimming observed on 171 imagery approximately 11/2000 UTC near center disk. Limited signal on available choreograph imagery but the potential remains for this to be earth directed if a CME was produced, perhaps into Day 4 (15 April) based on preliminary calculations. A further filament

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eruption from the SW disk early on the 12 April is also currently being analysed.
Solar winds may reach slightly elevated levels, with further coronal hole sourced enhancements possible, however any geomagnetic activity is likely to remain limited. Geomagnetic activity expected to be generally Quiet throughout, with isolated Unsettled spells likely and a slight chance of Active intervals, mostly associated with potential transitory CME impacts.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels. High energy (greater than 2 MeV) electron flux is expected to be at mostly background levels, perhaps peaking at high levels from day 2 (13 April) onwards. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 integrated pfu), perhaps on a rising trend.

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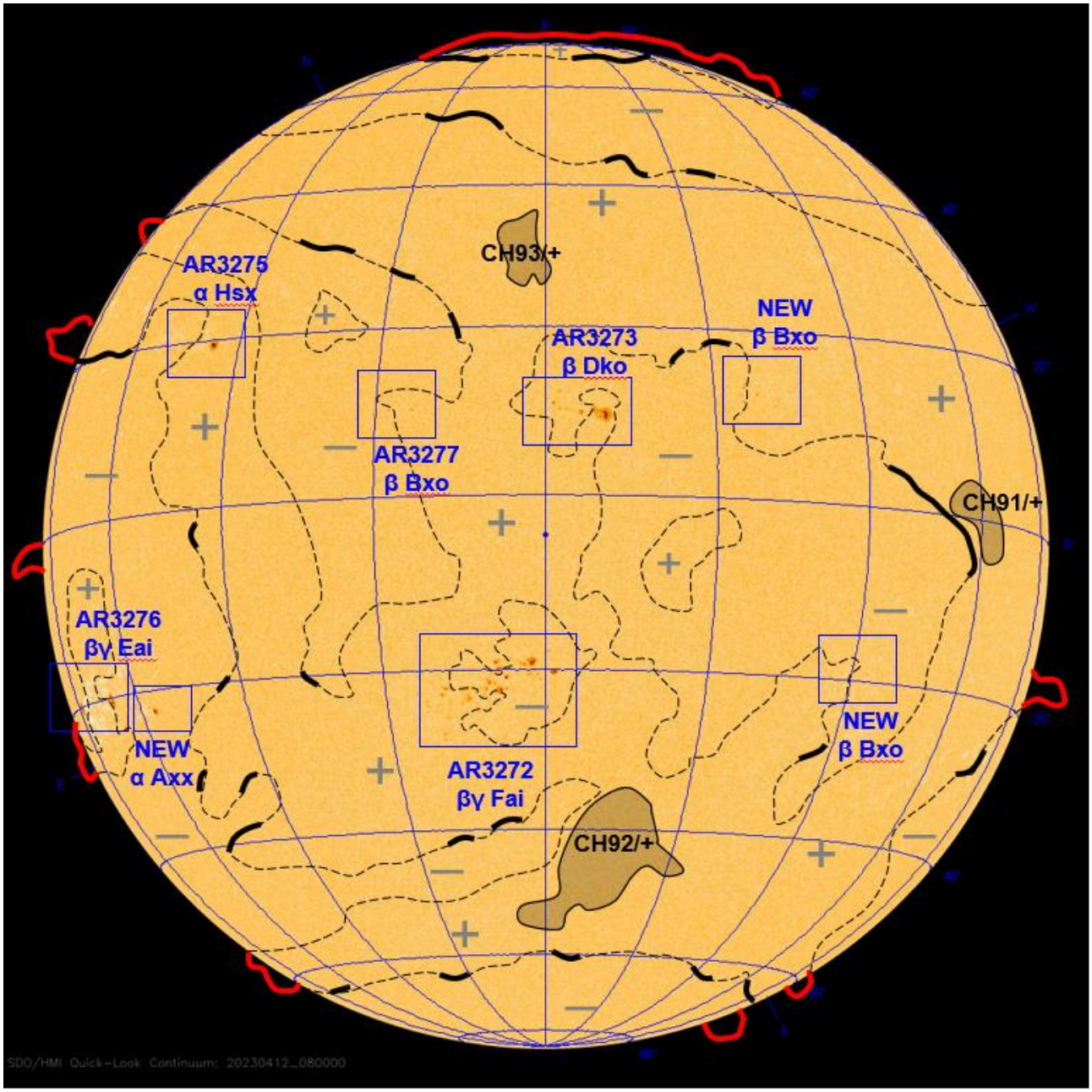
Figure 1. Solar Analysis Valid 12/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no expected Earth-directed CMEs, although there is a low possibility of a glancing arrival on Days 1 and 2 (12-13 April) associated with filament eruptions that left the sun on 9 and 10 of April. Investigation remains ongoing into dimming observed on 171 imagery approximately 11/2000 UTC near center disk. Limited signal on available choreograph imagery but the potential remains for this to be earth directed if a CME was produced, perhaps into Day 4 (15 April) based on preliminary calculations. A further filament eruption from the SW disk early on the 12 April is also currently being analysed.

Earth appears to be exiting from a weak HSS associated with CH91/+. Winds forecast to trend back towards background, although 27-day persistence is contaminated by the arrival of a CME on the last rotation. Further positive coronal holes are also present on the visible disk, CH92/+ in the south and CH91/+ in the north. These features give a potential for Earth to see slightly elevated solar winds from Day 2 (13 April) onwards, however due to their relatively high latitude positions and positive polarity, any geomagnetic enhancement is expected to remain subdued with limited ENLIL signal for solar wind enhancement.

The forecast for geomagnetic activity is therefore for generally Quiet conditions throughout, with isolated Unsettled spells likely and a slight chance of Active intervals, mostly associated with potential transitory CME impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
10/0220	Partial Halo	Filament eruption	SW Limb	540 km/s	14/0000UTC	Most likely to miss but low chance of a glancing blow

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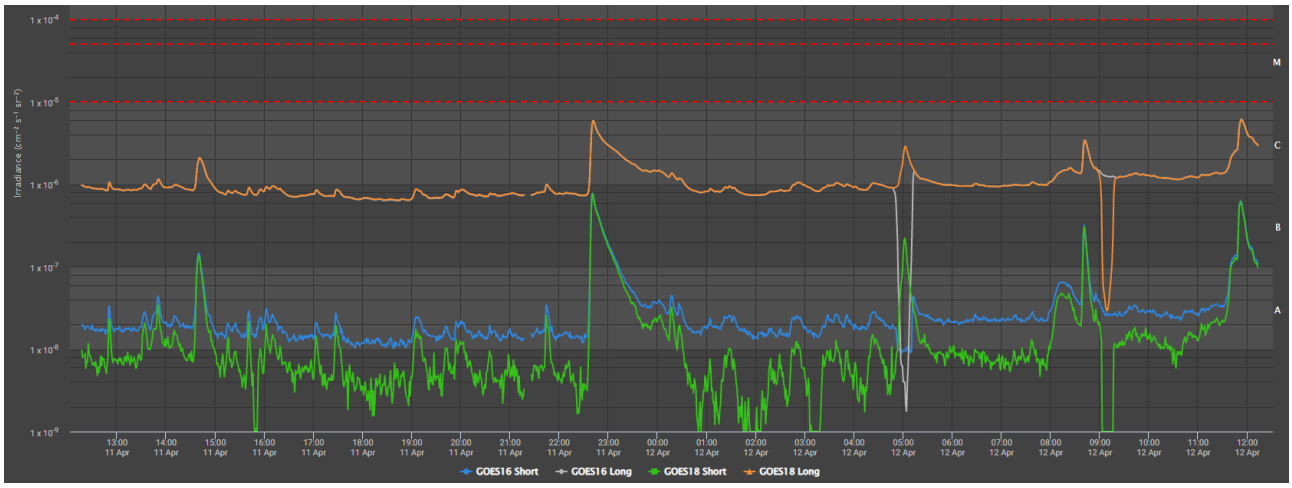
Radio Blackouts - X-Ray Flares:
Low to Moderate activity is expected with the ongoing chance of isolated M-flares and a slight chance of X-flares given the number of larger, more complex regions on the visible disk.
There are two sunspots which have a history of M-flaring, along with several low level C-flares. AR3272 is a moderately sized region in the central southern disk, and is comprised of multiple small spots, with some magnetic complexity due to a couple of small reverse polarity spots near the main negative leaders. AR3276 close to the southeast limb also has a history of M-class flares, however it remains more difficult to analyse given its position. On the far-side this region appeared to be a source of a number of CMEs, and has a bright appearance in SDO aia-094 imagery. More complexity is likely to become apparent as it moves into a less oblique viewing angle. The smaller spot proceeding it is tentatively recorded as an unnumbered separate development, with only fairly limited looping between the systems evident.

Further regions presently on the disc include AR3273 which has shown some limited development and displays a simpler bipolar magnetic structure. Along with a few further smaller spots, there is a current trend for slowly increasing activity and further sunspot development appears likely, as well as new regions rotating onto the visible side.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 2: 24hr X-Ray flare trace from GOES 18



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV), as observed by GOES-16, is likely to remain at background levels through the period, however there is a slightly increased risk given a number of larger, more complex active regions including AR3272, particularly as these rotate into the western disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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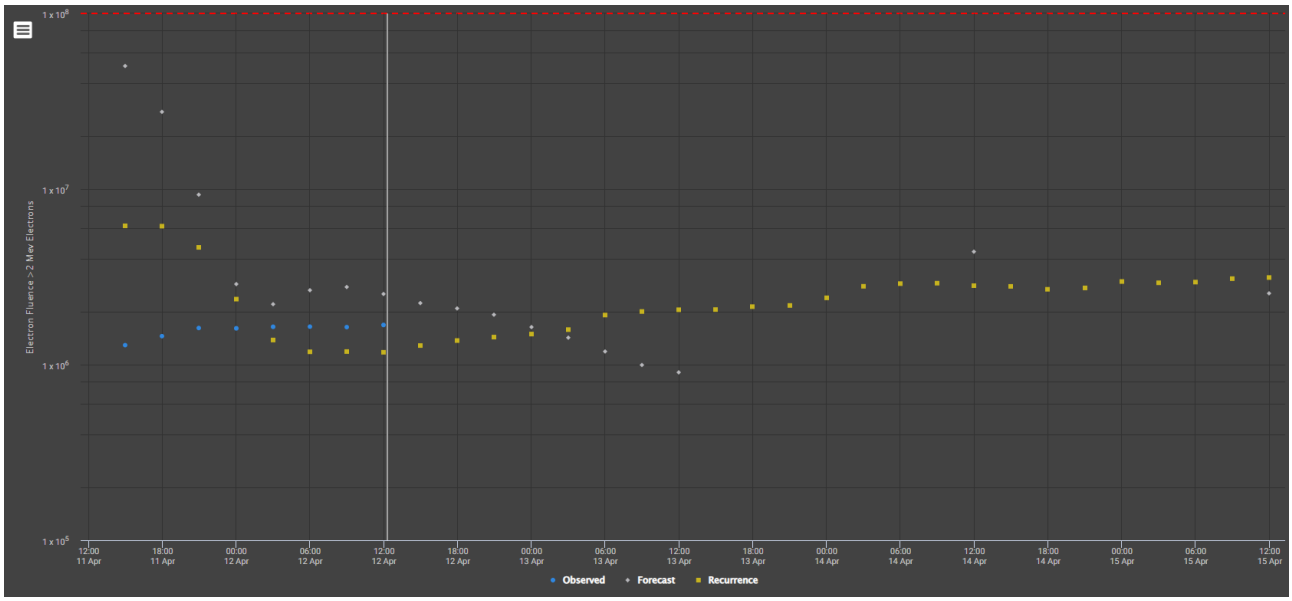
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux is currently at background levels and any rise due to the observed solar wind enhancements is expected to be subdued to start the period. Peak diurnal values might reach high levels from day 2 (13 April) onwards, but any rise is expected to be fairly modest and subject to uncertainty given the potential of glancing CME and HSS effects into the period.

The associated 24 hour fluence is currently expected to be below the Active (1e8 integrated pfu) threshold throughout, but perhaps with a slight rising trend. REFM is suggesting only minor rises and is presently considered to be giving good guidance. Probability increase into the period representing uncertainty in the prevailing geomagnetic conditions

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output



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